like the divisions of a polyp community, until now natural history has more than a dozen named branches; and in physics the divisions are almost as numerous. There are now at least thirty named and bounded sciences; each name designating a particularly limited field, in which there are able men who work their days out in labour that does not consider the rest of nature as having any relation to their work.

This progressive division of labour follows a natural law: and it is perhaps fit that science should itself give a capital illustration of the application of this law to forms of thought, as well as to the more concrete things of the world; but it is an open question whether or no it is advantageous to the best interests of learning. There can be no question that the search for truth of a certain quality is very greatly helped by this principle of divided labour. If a man wish to get the most measurable yield out of the earth in any way, the best thing for him is to stake off a very small claim, tie himself down to it, fertilise it highly, till it incessantly, and forget that there are blossoms or fruit beyond his particular patch; for any moment of consciousness of such impracticable things as grow beyond his field is sure to find expression when he comes to dig his crop, whether his crop in the intellectual field be elements or animals, stars or animalculæ. The harvest of things unknown is most easily won in this kitchen-gardening way of work.

The world needs, or fancies that it needs, this kind of work; and it is now of a mind to pay more of its various rewards for the least bit of special and peculiar knowledge than for the widest command of varied learning. In a thousand ways it says to its students, not only as of old, "Study what you most affect," but, "*Effect that study altogether*, know the least thing that can be known as no one else knows it, and leave the universe to look after itself."

This is the prescription of our time. We are now proceeding on the unexpressed theory that, because no man can command the details of all science, therefore he shall know only that which he can know in the utmost detail. We seem to be assuming, that, if many separate men each know some bit of the knowable, man in general will in a way know it all; that when, in another hundred years of this specialisation, we have science divided into a thousand little hermit-cells, each tenanted by an intellectual recluse, we shall have completed our system of scientific culture. No one can be so blind to the true purposes of learning as to accept this condition of things as the ideal of scientific labour. It may be the order of conquest, the shape in which the battle against the unknown has to be fought; but beyond it must lie some broader disposition of scientific life,—some order in which the treasures of science, won by grim struggle in the wilderness of things unknown, may yield their profit to man.

The questions may fairly be asked, whether we have not already won enough knowledge from nature for us to return, in part, to the older and broader ideal of learning; whether we may not profitably turn away a part of the talent and genius which go to the work of discovery to the wider task of comprehension; whether we may not again set the life of a Humboldt along with the life of a Pasteur, as equally fit goals for the student of nature.

Until we set about the system of general culture in science, it will be nearly impossible to have any proper use of its resources in education. A sound theory of general culture in science must be preceded by a careful discussion of the mind-widening power of its several lines of thought. This determination cannot be made by men versed only in their own specialties; it must be made by many efforts to determine by comparison what part of the sciences have the most important power of mind-developing. At present there are few men whose opinion on such a subject is worth anything, and the number constantly grows less.

The greatest difficulty partly expresses itself in, and partly rises from, the multiplication of societies which include specialists as members, and specialties as the subjects of their discussions. We no longer have much life in the old academies, where men of diverse learning once sought to give and receive the most varied teaching. The geologists herd apart from the zoologists: and in zoology the entomologists have a kingdom to themselves; so have the ornithologists, the ichthyologists, and other students. "That is not my department," is an excuse for almost entire ignorance of any but one narrow field. If naturalists would recognise this "pigeon-holing," not only of their work, but of their interests, as an evil, we might hope to see a betterment. Until they come to see how much is denied them in this shutting-out of the broad view of nature, there is no hope of any change. Special societies will multiply; men of this sort of learning will understand their problems less and less well; until all science will be "*caviare* to the general," even when the general includes nearly all others beyond the dozen experts in the particular line of research.

The best remedy for this narrowing of the scientific motive would be for each man of science deliberately to devote himself, not to one, but to two ideals, *i.e.* thorough individual work in some one field, and sound comprehension of the work of his fellows in the wide domain of learning—not all learning, of course, for life and labour have limits, but of selected fields. In such a system there will be one society-life meant for the promotion of special research, and another meant for the broader and equally commendable work of general comprehension.

It is in a certain way unfortunate that investigation is to a great extent passing out of the hands of teachers. This, too, is a part of the subdivision work; but it is in its general effects the most unhappy part of it. As long as the investigator is a teacher, he is sure to be kept on a wider field than when he becomes a solitary special worker in one department.

The efforts now being made for the endowment of research will, if successful, lead to a still further tendency to limit the fields of scientific labour. A better project would be to keep that connection between inquiry and exposition from which science has had so much profit in bygone times.

## *TWO GREEK GEOMETERS*

DR. ALLMAN in his article "On Greek Geometry from Thales to Euclid," in the current volume of *Hermathena* (vol. v. No. 10), discusses in Chapter IV. the discoveries of Archytas of Tarentum, and in Chapter V. those of the Greek geometer Eudoxus of Cnidus.

Archytas was a contemporary of Plato (428–347 B.C.), probably senior to him, and saved his life when Plato was in danger of being put to death by the younger Dionysius. These particulars and others of interest are skilfully arrayed by the author; one only of these we recall, viz. Horace's reference to the death of Archytas by shipwreck in an ode (Book I. 28), in which he recognises his eminence as an arithmetician, geometer, and astronomer. Unfortunately no undoubted works of his have come down to us; the authenticity of some that have been attributed to him is here discussed, but these do not treat of geometry. In former chapters his contributions to the doctrine of proportion and his demonstrations of theorems as well as solutions of problems have been noticed. Here the question of his identity with the Architas of Boethius' *Ars Geometriæ* is discussed, and a strong case made out for the same. The connection of Archytas with the Delian Problem (already touched upon in *Hermathena*, vol. iv.) next comes under consideration, and the passage in Eutocius is translated at length and accompanied by a figure. An enumeration of the theorems which occur in this passage is made,

whence we see that this geometer "was familiar with the generation of cylinders and cones, and had also clear ideas on the interpretation of surfaces; he had, moreover, a correct conception of geometrical loci and of their application to the determination of a point by means of their intersection." Dr. Allman further maintains that in this solution "the same conceptions are made use of, and the same course of reasoning is pursued, which, in the hands of his successor and contemporary Menœchmus, led to the discovery of the three conic sections. Such knowledge and inventive power surely outweigh in importance many special theorems." In arriving at these views he has to combat (which he does in some detail and apparently with success) the reasoning of Cantor, which is "based on a misconception of the passage in which the word *τόπος* occurs." Dr. Allman insists that *τόπος* means *place* and not *locus* (as used by mathematicians). The whole discussion is well worthy of the careful attention of all interested in the history of geometry: we must forbear to enter into the matter further.

Eudoxus (born about 407 B.C.), a pupil of Archytas, was an astronomer, geometer, physician, and lawgiver, and hence a noteworthy man in more ways than one. Here again Dr. Allman, one of whose great merits is his independence and his thorough examination of the original authorities, differs from Boeckh and Grote, but we cannot give details. A full discussion of the additions to geometry made by Eudoxus follows, and from it we learn how great he was as a geometer; his contributions to astronomy must be sought for elsewhere, though they too come under notice. "This eminent thinker—one of the most illustrious men of his age, an age so fruitful in great men, the precursor, too, of Archimedes and of Hipparchus —after having been highly estimated in antiquity, was for centuries unduly depreciated; and it is only within recent years that, owing to the labours of some conscientious and learned men, justice has been done to his memory, and his reputation restored to its original lustre." The article under notice will considerably conduce to this right placing of Eudoxus, amongst whose merits the least is not that he was a true man of science. "Of all the ancients, no one was more imbued with the true scientific and positive spirit than was Eudoxus." Five reasons for this statement follow, and the article closes. The whole paper is a most interesting as well as valuable one; indeed the interest grows as the author approaches his goal, and we venture to predict for Dr. Allman, when his articles appear in a volume, a most cordial welcome from all mathematicians.

## *THE ROYAL GARDENS AT KEW*

THE Report of the Director on the Progress and Condition of the Royal Gardens at Kew for the year 1882 was unavoidably delayed. It bears date only from November 1, 1883, and was not published until well on in 1884. The date of the Report has, however, nothing to say to its interest and merit, and there is always plenty of both in these too short accounts of the great work carried on at Kew. Passing over some details, noting that the amount of damage which the collections have suffered has been, notwithstanding the unprecedented number of visitors, practically *nil*, and that the lecture-classes for young gardeners continue to give satisfactory results, we find an account of the formation of a Rock Garden at Kew. The site selected lies between the wall bounding the Herbaceous Ground on the east and the New Range on the west. The general idea in laying out this space was to imitate in some measure the rocky course of some Pyrenean stream; the dry bed is represented by the broad walk (8 feet wide and 514 feet long), while on either side are the rock-piled banks, in the interstices and pockets of which grow the Alpine plants, and above all are thickets of box and rhododendrons. Tree stumps have been somewhat freely used here and there. That some plants grow well on them will be admitted; that by their decay they require renewal is their chief drawback. The collection of 2630 plants bequeathed to the Gardens by Mr. Joad formed a splendid commencement to the Rock Garden series, and this section of the grounds has long since proved not only a centre of attraction to the general visitors, but has been a source of pleasure and profitable study to many an amateur gardener. An apology is made for not attempting some geographical arrangement of the Alpines; one was hardly needed. Where the plants grow best there ought to be their (artificial) habitat, and the practical gardener well knows what strange bedfellows plants often are, and how marvellously they vary in their tastes. Within the last six weeks we noted two finely-grown plants of that popular Alpine cudweed, the edelweiss; one was flowering out of a crack in a dry limestone wall, the other was on a deep clay bank.

The elaboration of the natural family of the palms for the "Genera Plantarum" of Bentham and Hooker led the Director to make a critical study of the species of palms in cultivation at Kew, the collection of which proved to be of unexpected richness. In an appendix is a classified list of 420 palms at present in cultivation at Kew. This collection has now but two rivals—the magnificent collection at Herrenhausen, Hanover, chiefly made by Herr Wendland, and that of the unrivalled tropical gardens at Buitenzorg in Java.

The report about the Arboretum shows an enormous amount of work accomplished. While the collection is one of the richest in existence, its importance is gradually more and more dawning upon those interested in planting, and its national importance in this respect should not be overlooked.

The part of the Report giving extracts from the large colonial correspondence that centres at Kew is full of interest, none the less so that much of the information is of a date often far on in 1883. The Argan tree seems likely to be acclimatised at Natal from seeds sent from Kew. The india-rubber (Ceara), introduced from Kew into Ceylon, seems in a fair way of paying as well as Cinchona. Dr. Trimen says it will grow anywhere up to almost 2500 feet, and its commercial success is most satisfactory. "About six months ago (October 24, 1883) some Ceara-rubber seed was imported from Ceylon into Southern India. The produce of these trees may now be seen flourishing in a wonderful manner at the foot of the Neilgherry Hills. The rapid growth of the trees is marvellous. Some which were six months old from seed were fully eight feet high; and a cutting, said to have been planted scarcely six months previously, was quite eight feet high, and was in blossom. It seems to thrive on poor soil, requires shelter but not shade, and very little rain. The demand for the produce seems to be unlimited." Of the mahogany seeds sent from Kew in 1868 to Mauritius, nine of the trees raised bore seeds in 1881, and numerous seedlings were found self-sown. In a report from the Seychelles allusion is made to "three different diseases which have seriously affected the cocoa-nut palms," whereby large forests of these valuable trees have been destroyed. No details are given as to what these diseases are, though they "have nearly stopped their depredations since 1882." In the same report it is mentioned that the remains of the clove plantations cover "about 250 acres"—surely a mistake. It is also stated that the Liberian coffee sent from Kew in 1880 has proved a success, and that about 100 acres of it have been recently planted. The report on *Cinchona robusta* quotes with approval Dr. Trimen's views on the hybrid forms of the Nilgiris—known under the names *pubescens* and *magnifolia*—now settled to be hybrids between *C. succirubra* and *C. officinalis*.

Among the more important additions to the Herbarium may be mentioned the collection of European and exotic lichens made by the Rev. W. A. Leighton, the type speci-